What we claim is:

1. A sheet of multiple surface mount electronic devices forming rows and columns of solder ball arrays and solid or semi-solid thermoplastic adhesive adhered to available surfaces between said rows or columns or both.

2. The sheet of claim 1, wherein the thermoplastic adhesive is laid in strips centered between the said rows or columns or both.

3. The sheet of claim 1, wherein a thermoplastic adhesive pre-form is applied between said rows or columns or both

4. A process for singulating surface mounted electronic devices from a sheet of surface mounted electronic devices forming rows and columns of solder ball arrays and solid or semi-solid thermoplastic adhesive adhered to available surfaces between said rows or columns or both, comprising cutting each surface mounted electronic device from the sheet along the length of the thermoplastic adhesive.

5. A solid or semi-solid thermoplastic adhesive pre-form having a shape corresponding to a pre-selected pattern on available surfaces of a sheet of ball grid array integrated circuits.

6. The pre-form of claim 5,wherein the thermoplastic adhesive is a solid.

7. The pre-form of claim 6, having a thickness ranging from 5 mils to 15 mils.

8. The pre-form of claim 7, having a thickness ranging from 8 mils to 13 mils.

9. An assembly comprising a surface mounted electronic device and a printed circuit board defining an assembly gap width between the device and the printed circuit board before solder reflow, said surface mounted electronic device comprising an organic connecting substrate having terminal leads or solder bumps and having a bottom surface facing the printed circuit board, said bottom surface comprising a semi-solid or solid thermoplastic adhesive attached to a portion of the bottom surface, wherein the terminal leads or solder bumps are mounted on landing pads on the printed circuit board, and the thermoplastic adhesive has a height which is less than the assembly gap width to provide a second gap between the thermoplastic adhesive and the printed circuit board.

10. The assembly of claim 9, wherein the thermoplastic adhesive has a height which is at least 25% and no more than 90% of the assembly gap width.

11. The assembly of claim 10, wherein the thermoplastic adhesive height is at least 40% of the assembly gap width.

12. The assembly of claim 9, wherein the thermoplastic adhesive height is no more than 70% of the assembly gap height.

13. The assembly of claim 9, wherein the surface mounted electronic device is a leaded surface mounted electronic device.

14. The assembly of claim 13, wherein the surface mounted electronic device is a PBGA, μBGA, flip chip BGA, stacked die BGA, or flex tape BGA.

15. The assembly of claim 9, wherein the printed circuit board is flexible.

16. The assembly of claim 9, wherein the printed circuit board is a material comprising a polyimide, polyester, polycyclohexylene terephthalates, liquid crystal polymers, polyphenylene sulfide, liquid crystal polymers, polyether sulfone, polyether ether ketone, aramid, polycarbonate or polyarylate, phenolic resin impregnated paper under the FR-2 classification, a epoxy resin impregnated paper under the FR-3 classification, CEM-1, and glass fibers impregnated with epoxy resins under the FR-4 classification.

17. The assembly of claim 16, wherein the printed circuit board is a material comprising a polyimide polymer, or phenolic resin impregnated paper under the FR-2 classification, a epoxy resin impregnated paper under the FR-3 classification, CEM-1, and glass fibers impregnated with epoxy resins under the FR-4 classification., or polycyclohexylene terephthalates.

18. The assembly of claim 9, wherein the thermoplastic adhesive is electrically non-conducting.

19. The assembly of claim 9, wherein the thermoplastic adhesive is applied as a solid or semi-solid to an available surface on said bottom surface.

20. The assembly of claim 9, wherein the surface mounted electronic device comprises a BGA having an array of solder bumps on said bottom surface of the connecting substrate, and the thermoplastic adhesive is applied as strips spanning the length of at least two perimeter edges on said bottom surface.

21. The assembly of claim 9, wherein the surface mounted electronic device comprises a BGA having an array of solder bumps on said bottom surface of the connecting substrate, and the thermoplastic adhesive is applied on each corner of the bottom surface.

22. The assembly of claim 9, wherein the surface mounted electronic device comprises a BGA having an array of solder bumps on said bottom surface of the connecting substrate, and the thermoplastic adhesive is applied between each of the four corners on the bottom surface.

23. The assembly of claim 9, wherein the thermoplastic adhesive is attached to the connecting substrate by application of heat to the thermoplastic adhesive, the connecting substrate, or both, sufficient to render the thermoplastic adhesive tacky.

24. The assembly of claim 9, wherein the thermoplastic adhesive is attached to the connecting substrate by application of heat to the thermoplastic adhesive, the connecting substrate, or both, laying down the thermoplastic adhesive on an available surface of the

connecting substrate, followed by applying pressure to the thermoplastic adhesive.

25. The assembly of claim 9, wherein the thermoplastic adhesive is attached to the connecting substrate through a pressure sensitive adhesive by application of pressure to the thermoplastic adhesive .

26. The assembly of claim 9, wherein the thermoplastic adhesive has a complex viscosity of at least 50 Pa•s, and is a solid or semi-solid at 55°C.

27. The assembly of claim 26, wherein the thermoplastic adhesive has a complex viscosity of at least 80 Pa•s, and is a solid at 80°C.

28. The assembly of claim 27, wherein the thermoplastic adhesive is a solid or semi-solid at 100°C.

29. The assembly of claim 9, wherein the thermoplastic adhesive has a storage modulus of at least 100 Pa at temperatures of up to 125°C, as measured in a parallel plate rheometry test at a 1" circular plate gap width of 1mm, and a heat rate of 2°C per minute, and a shear rate of 0.1 radians per second.

30. The assembly of claim 29, wherein the thermoplastic adhesive has a storage modulus of at least 1000 Pa at temperatures up to 125°C.

31. The assembly of claim 9, wherein the thermoplastic adhesive has a complex viscosity of at least 50 Pa•s at any temperature ranging from 140°C to 220°C, as measured

in a parallel plate rheometry test at a 1" circular plate gap width of 1mm, and a heat rate of 2°C per minute starting at 140°C, and at a shear rate of 0.1 radians per second.

32. The assembly of claim 31, wherein the thermoplastic adhesive has a complex viscosity of at least 80 Pa•s at any temperature ranging from 140°C to 220°C.

33. The assembly of claim 32, wherein the thermoplastic adhesive has a complex viscosity of at least 100 Pa•s at any temperature ranging from 140°C to 220°C.

34. The assembly of claim 33, wherein the thermoplastic adhesive has a complex viscosity of at least 175 Pa•s at any temperature ranging from 140°C to 220°C.

35. The assembly of claim 31, wherein the thermoplastic adhesive has a complex viscosity which does not exceed 5000 Pa•s at 220°C.

36. The assembly of claim 35, wherein the thermoplastic adhesive has a complex viscosity which does not exceed 2500 Pa•s at 220°C.

37. The assembly of claim 9, wherein the thermoplastic adhesive has a tensile elongation of at least 50%.

38. The assembly of claim 37, wherein the thermoplastic adhesive has a tensile elongation of at least 100%.

39. The assembly of claim 38, wherein the thermoplastic adhesive has a tensile elongation of at least 150%.

40. The assembly of claim 9, wherein the thermoplastic adhesive has a Youngs modulus ranging from 5 MPa to 2000 MPa.

41. The assembly of claim 40, wherein the thermoplastic adhesive has a Youngs modulus ranging from 70 MPa to 300 MPa.

42. The surface mount device of claim 9, wherein the thermoplastic adhesive has a tensile strength of at least 500 psi to 4000 psi.

43. The assembly of claim 9, wherein the thermoplastic adhesive comprises a functionalized polyolefin.

44. The assembly of claim 43, wherein the amount of the functionalized polyolefin is at least 20 wt.%, based on the weight of the thermoplastic adhesive.

45. The assembly of claim 43, wherein the functionalized polyolefin is functionalized with acid groups, amine groups, or a combination thereof.

46. The assembly of claim 45, wherein the functionalized polyolefin is functionalized with a functionalizing agent comprising unsaturated mono- or polycarboxylic acid monomers or the acid derivatives thereof.

47. The assembly of claim 46, wherein the functionalizing agent comprises itaconic acid, acrylic acid, methacrylic acid, ethylacrylic acid, butylacrylic acid, maleic acid, the ester and anhydride derivatives thereof, or vinyl acetate.

48. The assembly of claim 43, wherein the functionalized polyolefin comprises an amine functionalized polyolefin.

49. The assembly of claim 9, wherein the thermoplastic adhesive comprises a polyamide polymer.

50. The assembly of claim 49, wherein the thermoplastic adhesive comprises a functionalized polyamide polymer.

51. The assembly of claim 49, wherein the polyamide has a complex viscosity ranging from 2000 cps to 12,000 cps at 190°C.

52. The assembly of claim 49, wherein the polyamide has a number average molecular weight Mn within a range of 500 and up to 8000.

53. The assembly of claim 49, wherein the polyamide has a number average molecular weight Mn within a range of 5000 to 100,000.

54. The assembly of claim 9, wherein the thermoplastic adhesive comprises

(A) from 5% to 98% by weight of a functionalized polyolefin, and

(B) from 2% to 95% by weight of a polyamide compound.

55. The assembly of claim 54, wherein the weight ratio of the functionalized polyolefin to the polyamide compound ranges from 98:2 to 40:60, respectively.

56. A process for adhering a printed circuit board having landing pads to a surface mount electronic device

comprising an organic connecting substrate having an upper surface and a bottom surface, and solder bumps disposed on a bottom surface or having terminal leads disposed on the connecting substrate, comprising:

a) attaching a thermoplastic adhesive onto a portion of the bottom surface of the connecting substrate;

b) mounting the electronic device onto a printed circuit board to form an assembly in which the terminal leads or solder bumps are aligned with corresponding landing pads on the printed circuit board and the adhesive faces the printed circuit board and wherein a gap is provided between the thermoplastic adhesive and the printed circuit board; and

c) heating the assembly under solder reflow conditions effective to provide an adhesive bond between the organic bottom surface of the electronic device and the printed circuit board and effective to provide a solder joint between the connecting substrate and the landing pads on the printed circuit board.

57. The process of claim 56, wherein the thermoplastic adhesive sags sufficiently during heating in step c) to contact and adhere to the printed circuit board.

58. The process of claim 56, wherein the thermoplastic adhesive does not impinge on any solder joints.

59. The process of claim 56, wherein the surface mounted electronic device is a ball grid array.

60. The process of claim 56, wherein the surface mounted electronic device remains bonded to the printed circuit board when deflected around a 1.5" mandrel.

61. The process of claim 61, wherein the surface mounted electronic device remains bonded to the printed circuit board when deflected around a 0.75" mandrel.

62. The process of claim 56, wherein 50% of the surface mounted electronic devices exhibit a circuit failure at 15 or more drops, as measured in a gravity drop test wherein an assembly weighted for its intended application is dropped on the face of the assembly opposing the surface mounted electronic device in a free fall from a height of 2 meters onto a concrete pad.

63. The process of claim 62, wherein 50% of the surface mounted electronic devices exhibit circuit failure at 30 or more drops.

64. The process of claim 63, wherein 50% of the surface mounted electronic devices exhibit circuit failure at 40 or more drops.

65. The process of claim 62, wherein 100% of the surface mounted electronic devices exhibit circuit failure at 80 or more drops.

66. The process of claim 65, wherein 100% of the surface mounted electronic devices exhibit circuit failure at 100 or more drops.

R 1.126 67. ~~66.~~ The process of claim 56, wherein the thermoplastic adhesive has the following properties:

a) a complex viscosity of at least 50 Pa•s at any temperature ranging from 140°C to 220°C, and which

does not exceed 5000 Pa•s at 220°C, as measured in a parallel plate rheometry test at a 1" circular plate gap width of 1mm, and a heat rate of 2°C per minute starting at 140°C, and at a shear rate of 0.1 radians per second;

b) has a storage modulus of at least 100 Pa at temperatures of up to 125°C;

c) is a solid or semi-solid at 55°C; and

d) a tensile elongation of at least 50%.

68. ~~67.~~ The process of claim 66, wherein the thermoplastic adhesive has the following properties:

a) a complex viscosity of at least 100 Pa•s at any temperature ranging from 140°C to 220°C, and which does not exceed 2500 Pa•s at 220°C, as measured in a parallel plate rheometry test at a 1" circular plate gap width of 1mm, and a heat rate of 2°C per minute starting at 140°C, and at a shear rate of 0.1 radians per second;

b) has a storage modulus of at least 1000 Pa at temperatures of up to 125°C;

c) is a solid or semi-solid at 100°C; and

d) a tensile elongation of at least 150%.

69. ~~68.~~ The process of claim 67, wherein the thermoplastic adhesive has a Youngs modulus ranging from 70 to 300 MPa.

70. ~~69.~~ The process of claim 67, wherein the thermoplastic adhesive has a tensile strength of at least 500 psi to 4000 psi.

71. ~~70~~. A process for adhering a printed circuit board comprising landing pads to a surface mount electronic device comprising a connecting substrate having a bottom surface with leads, said process comprising adhering a thermoplastic adhesive onto a portion of said bottom surface, mounting the electronic device onto a printed circuit board to form an assembly in which the leads on said bottom surface are aligned with corresponding landing pads and the thermoplastic adhesive faces the printed circuit board forming a gap between the thermoplastic adhesive and the printed circuit board, followed by heating the assembly under solder reflow conditions effective to provide an adhesive joint between said bottom surface and the printed circuit board, wherein the thermoplastic adhesive comprises a functionalized polyolefin.

72. ~~71~~. The process of claim 70, wherein the amount of the functionalized polyolefin in the thermoplastic adhesive is at least 3% by weight.

73. ~~72~~. The process of claim 71, wherein the amount of the functionalized polyolefin is at least 20 wt.%, based on the weight of the thermoplastic adhesive.

74. ~~73~~. The process of claim 72, wherein the functionalized polyolefin is functionalized with acid groups, amine groups, or a combination thereof.

75. ~~74~~. The process of claim 73, wherein the polyolefin is functionalized with an unsaturated mono- or polycarboxylic acid monomers or derivatives thereof, in an amount ranging from 0.05 wt.% to 50%, based on the weight of the functionalized polyolefin.

76. ~~75~~. The process of claim 70, wherein the surface mounted electronic device remains bonded to the printed circuit board when deflected around a 1.5" mandrel.

77. ~~76~~. The process of claim 75, wherein the surface mounted electronic device remains bonded to the printed circuit board when deflected around a 0.75" mandrel.

78. ~~77~~. The process of claim 70, wherein 50% of the surface mounted electronic devices exhibit a circuit failure at 15 or more drops, as measured in a gravity drop test wherein an assembly weighted for its intended application is dropped on the face of the assembly opposing the surface mounted electronic device in a free fall from a height of 2 meters onto a concrete pad.

79. ~~78~~. The process of claim 77, wherein 50% of the surface mounted electronic devices exhibit circuit failure at 30 or more drops.

80. ~~79~~. The process of claim 77, wherein 50% of the surface mounted electronic devices exhibit circuit failure at 40 or more drops.

~~80~~. The process of claim 77, wherein 100% of the surface
81. mounted electronic devices exhibit circuit failure at 80 or more drops.

82. ~~81~~. The process of claim 77, wherein 100% of the surface mounted electronic devices exhibit circuit failure at 100 or more drops.

83. ~~82~~. A process for adhering a printed circuit board comprising landing pads to a surface mount electronic device comprising a connecting substrate having a bottom surface with leads, said process comprising adhering a thermoplastic adhesive onto a portion of said bottom surface, mounting the electronic device onto a printed

circuit board to form an assembly in which the leads on said bottom surface are aligned with corresponding landing pads and the thermoplastic adhesive faces the printed circuit board forming a gap between the thermoplastic adhesive and the printed circuit board, followed by heating the assembly under solder reflow conditions effective to provide an adhesive joint between said bottom surface and the printed circuit board, wherein the thermoplastic adhesive comprises a polyamide resin in an amount of at least 10 wt.%.

84. ~~83~~. The process of claim 82, wherein the surface mounted electronic device remains bonded to the printed circuit board when deflected around a 1.5" mandrel.

85. ~~84~~. The process of claim 83, wherein the surface mounted electronic device remains bonded to the printed circuit board when deflected around a 0.75" mandrel.

86. ~~85~~. The process of claim 82, wherein 50% of the surface mounted electronic devices exhibit a circuit failure at 15 or more drops, as measured in a gravity drop test wherein an assembly weighted for its intended application is dropped on the face of the assembly opposing the surface mounted electronic device in a free fall from a height of 2 meters onto a concrete pad.

87. ~~86~~. The process of claim 85, wherein 50% of the surface mounted electronic devices exhibit circuit failure at 30 or more drops.

88. ~~87~~. The process of claim 85, wherein 50% of the surface mounted electronic devices exhibit circuit failure at 40 or more drops.

~~88~~. The process of claim 85, wherein 100% of the surface
89. mounted electronic devices exhibit circuit failure at 80 or more drops.

90.
~~89~~. The process of claim 85, wherein 100% of the surface mounted electronic devices exhibit circuit failure at 100 or more drops.

91.
~~90~~. A process for adhering a printed circuit board comprising landing pads to a surface mount electronic device comprising a connecting substrate having a bottom surface with leads, said process comprising adhering a thermoplastic adhesive onto a portion of said bottom surface, mounting the electronic device onto a printed circuit board to form an assembly in which the leads on said bottom surface are aligned with corresponding landing pads and the thermoplastic adhesive faces the printed circuit board forming a gap between the thermoplastic adhesive and the printed circuit board, followed by heating the assembly under solder reflow conditions effective to provide an adhesive joint between said bottom surface and the printed circuit board, wherein the thermoplastic adhesive comprises:

(A) from 5% to 98% by weight of a functionalized polyolefin, and

(B) from 2% to 95% by weight of a polyamide compound.

92.
~~91~~. The process of claim 90, wherein the polyamide comprises a functional terminated polyamide compound comprising an acid or an amine functionality and having a terminal functional group content of at least 0.04 to 4 meq/g.

93.
~~92~~. The process of claim 91, wherein the polyamide compound and functionalized polyolefin are substantially un-reacted with each other at solder reflow conditions.